Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service	)	IB Docket No. 05-20
	)	
	)	
	)	

NOTICE OF PROPOSED RULE MAKING

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By the Commission:

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I. INTRODUCTION

1. In this Notice of Proposed Rulemaking (*Notice* or NPRM), we make proposals and seek comment on a regulatory framework for licensing the operation of Aeronautical Mobile Satellite Service (AMSS)[1] systems to communicate with fixed-satellite service (FSS) networks in the Ku-Band[2] frequencies. Aircraft Earth stations (AES)[3] in the AMSS can be used to provide broadband telecommunications services on passenger, government, and executive/private aircraft. Our goal is to promote more efficient use of the spectrum while protecting and providing regulatory certainty to the existing primary allocations, including the fixed satellite service (FSS) operators, and sharing spectrum with other secondary operations in these frequency bands, including government space research (SRS) stations. Our proposals would enable important new communications services to be provided to crew and consumers on board aircraft. They would also protect existing terrestrial FS and FSS operations from harmful interference from AMSS stations and allow for future growth of FS and FSS networks. With regard to the secondary government space research stations and radio astronomy operations in parts

[1] The Mobile Satellite Service (MSS) is a radio communication service between mobile earth stations and one or more space stations. *See* 47 C.F.R. § 2.1 A mobile earth station is an earth station intended for use while in motion or during halts at unspecified points. *See* 47 C.F.R. § 25.201. The Mobile Satellite Service encompasses the land mobile-satellite service, the maritime mobile-satellite service, and the aeronautical mobile-satellite service.

[2] For purposes of this *Notice*, the "conventional" Ku-band refers to frequencies in the 11.7-12.2 GHz (downlink) and 14.0-14.5 GHz (uplink) bands and excludes the so-called "extended Ku-band" at 12.75-13.25 GHz, 13.75-14.0 GHz, 10.7-10.95 GHz, 10.95-11.2 GHz, 11.2-11.45 GHz, and 11.45-11.7 GHz. The "conventional" Ku-bands are allocated on a primary basis to the FSS. *See generally* 47 C.F.R. § 2.106.

[3] The term "aircraft Earth station" refers to any mobile earth station in the aeronautical mobile-satellite service located on board an aircraft. *See, e.g.*, 47 C.F.R. § 87.5.

of the Ku-Band, our proposals would provide protection to existing and accommodate future stations of these national assets. Our proposals also seek to establish a regulatory scheme that could enable foreign-licensed AES terminals to operate in the United States airspace without causing harmful interference to domestic operations.

2. This Notice continues our efforts to meet the growing demand for two-way broadband data and communications capabilities for commercial aircraft passengers and crew. The 2003 World Radiocommunications Conference (WRC-03) added a worldwide secondary AMSS allocation in the 14.0-14.5 GHz band.[4] In 2003, the Commission conformed the U.S. Table of Frequency Allocations ("U.S. Table" or "Table") to this international allocation, finding it desirable because it will facilitate an important new use of the 14.0-14.5 GHz band.[5] Examining alternative approaches for licensing AMSS in the Ku-band also advances the Commission's goals and objectives for market-driven deployment of broadband technologies and efficient spectrum usage. Broadband technologies, which encompass all evolving high-speed digital technologies that provide consumers integrated access to e-mail, voice, high-speed data, video-on-demand, and interactive delivery services, are a fundamental component of modern communications.[6] Fully evolved digital broadband will virtually eliminate geographic distance as an obstacle to acquiring information, and dramatically reduce the time it takes to access information. Consumers benefit as broadband technologies are developed and deployed.[7] AMSS potentially offers consumers the benefits of broadband services while traveling by air, both domestically and

[4] *See WRC-03 Provisional Final Acts* at 34-38. These pages show a new "Mobile-satellite (Earth-to-space)" allocation in this band in all three Regions, as well as new footnote 5.AA13 (since re-numbered as 5.504A), which reads: "In the band 14-14.5 GHz, aircraft earth stations in the secondary aeronautical mobile-satellite service may also communicate with space stations in the fixed-satellite service. The provisions of Nos. 5.29, 5.30 and 5.31 apply." ITU Radio Regulation Nos. 5.29. 5.30, 5.31 state that stations of a secondary service:

> 5.29 a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
>
> 5.30 b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;
>
> 5.31 c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

[5] Amendment of Parts 2, 25, and 87 of the Commission's Rules to Implement Decisions from the World Radiocommunications Conferences Concerning Frequency Bands Between 28 MHz and 36 GHz and to Otherwise Update the Rules in this Frequency Range, ET Docket No. 02-305, *Report and Order*, 18 FCC Rcd 23426 at para. 76 (2003) ("*Above 28 MHz Allocation Order*").

[6] *See* Federal Communications Commission Strategic Plan FY 2003-FY 2008, page 10, Means and Strategies to meet Goal 1 - Broadband, http://www.fcc.gov/omd/strategicplan/strategicplan2003-2008.pdf.

[7] We note that in a separate proceeding, the Commission has launched an examination of the appropriate legal and policy framework of the Communications Assistance for Law Enforcement Act (CALEA), including the applicability of CALEA to broadband internet access services (including those delivered by satellite systems). *See* Communications Assistance for Law Enforcement Act and Broadband Access and Services, ET Docket No. 04-295, *Notice of Propose Rulemaking and Declaratory Ruling*, 19 FCC Rcd 15676 (2004). To the extent any rules are adopted in that proceeding regarding CALEA obligations of satellite-based providers of broadband internet access, we anticipate that AMSS operators might also be subject to such rules.

internationally.[8] Such service might be particularly attractive to passengers on long-haul flights. AMSS provides a means for passengers to access high-speed Internet and interactive entertainment, while broadband capability for crews could "enhance aircraft operations through real-time equipment and supply information, weather updates, [and] security monitoring."[9] This *Notice* responds to an emerging marketplace need by potentially permitting more flexible use of the Ku-band while protecting existing services from harmful interference.[10]

3. In this *Notice,* we seek comment on methods for authorizing and licensing AMSS stations that are consistent with the WRC-03 outcome and that would also help ensure that AMSS operations would not cause harmful interference to terrestrial and satellite operations. First, we examine frequency allocation issues in the Ku-band, where AMSS will operate. Next, we discuss and seek comment on rules and procedures to license AMSS networks that consist of hub earth stations and/or aircraft earth stations (AESs) for operation over geostationary satellite orbit (GSO) FSS satellites in the Ku-band. The AMSS licensing procedure that we propose for the Ku-band would permit blanket licensing of an AMSS network similar to the licensing rules for very small aperture terminals (VSATs) that currently operate in the Ku-band.

4. This *Notice* seeks comment on licensing procedures for AMSS with a goal of maximizing the efficient use of Ku-band spectrum, and respecting the operational and protection expectations of incumbent licensees. Our proposals are designed to encourage AES terminals to utilize the Ku-band to the maximum extent possible. The Notice also seeks comments on licensing methods for AES terminals that will minimize the burdens upon applicants and licensees, while maintaining operational limitations necessary to avoid harmful interference. Finally, the *Notice* seeks comment on procedures to protect both space research service and radio astronomy service sites from AMSS operations in the 14.0-14.5

[8] We note that AMSS is distinct from AMS(R)S. AMS(R)S is a radio service providing communications via satellite between an aircraft earth station (AES) and land stations or other AESs, regulated under Part 87 (Aviation Services) of our rules. *See* 47 C.F.R. Part 87. AMS(R)S is allocated to the 1549.5-1558.5 MHz and 1651-1660 MHz bands on a co-primary basis with the mobile satellite service and in the 1545-1549.5 MHz and 1646.5-1651 MHz bands on a primary basis. *See* 47 C.F.R. § 2.106. AMS(R)S was formerly referred to as AMSS(R). The "(R)" in both terms indicates that the spectrum is used for aeronautical communications related to the safety and regularity of flights primarily along national and international civil air routes. AMS(R)S provides communications supporting operational control of both domestic and international air traffic. Such communications are important to the safe, efficient and economical operation of aircraft, and may convey information critical to aviation, such as aircraft position reports, performance, essential services and supplies, and weather information. *See* 47 C.F.R. § 87.261(a). Public correspondence – private or personal messages of passengers or crew – is prohibited. By contrast, AMSS is a service for aircraft passengers that can also be used by crew, but is not necessarily intended to provide critical flight support. Because of this dual nature (*i.e.*, AMSS can be used by passengers and/or crew for personal use and/or flight support), we find that it is appropriate to consider AMSS within the scope of Part 25 (Satellite Communications) of our rules.

[9] Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum in the 14-14.5 GHz Band to the Aeronautical Mobile-Satellite Service ("AMSS") and To Adopt Licensing and Service Rules for AMSS Operations in the Ku-Band, The Boeing Company, Petition for Rulemaking at 27, filed July 21, 2003 ("Boeing Petition" or "Petition").

[10] *See* Federal Communications Commission Strategic Plan FY 2003-FY 2008, page 14, Means and Strategies to meet Goal 2 – Spectrum, http://www.fcc.gov/omd/strategicplan/strategicplan2003-2008.pdf.

GHz band.[11]

II. BACKGROUND

A. Current AMSS Use

5. In December 2000, the Boeing Company ("Boeing") filed an application for blanket authority to operate up to 800 transmit and receive earth stations aboard aircraft in the Ku-band (using the 12 GHz band for space-to-Earth transmissions and the 14 GHz band for Earth-to-space transmissions).[12] In April 2001, the International Bureau and the Office of Engineering and Technology granted a waiver to Boeing so that it could operate up to 800 receive-only mobile earth stations aboard aircraft in the 12 GHz band.[13] In December 2001, that waiver grant was expanded to include the operation of two-way mobile earth stations (in a phased array antenna design) aboard aircraft in the 14.0-14.5 GHz band (uplink) and the 11.7-12.2 GHz (downlink) band.[14] Boeing was initially authorized to communicate with the Telstar 6 satellite at 93° W.L., and later received authority to communicate with the Americom 4 satellite at 101° W.L. as well.[15] Under its current authorization, Boeing is not permitted to cause harmful interference to other allocated services in the 11.7-12.2 GHz and 14-14.5 GHz frequency bands, and must accept all interference from authorized users of these bands.[16] According to its authorization, Boeing is permitted to operate AES terminals on board U.S.-registered aircraft traveling through United States airspace,[17] including airspace over United States territorial waters.[18] In 2003, the

[11] *See* "Memorandum of Understanding Between the Federal Communications Commission and the National Telecommunications and Information Administration Addressing the Aeronautical Mobile-Satellite Service In the 14.0-14.5 GHz Band," July 8, 2002

[12] *See* Application of The Boeing Company for Blanket Authority to Operate up to Eight Hundred Technically-Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 11.7-12.2 and 14.0-14.5 GHz Frequency Bands, File No. SES-LIC-20001204-02300 (December 4, 2000, supplemented January 10, 2001) ("*Boeing Two-Way AMSS Application*").

[13] Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands, *Order and Authorization*, 16 FCC Rcd 5864 (International Bureau and Office of Engineering and Technology, 2001).

[14] Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands, *Order and Authorization*, 16 FCC Rcd 22645 (International Bureau and Office of Engineering and Technology, 2001) ("*Boeing Transmit-Receive Order*"). A waiver of Section 2.106 of the Commission's rules was necessary because at that time the U.S. Table of Allocations did not include an allocation for AMSS downlinks in the 12 GHz band, nor did it include an allocation for AMSS uplinks in the 14 GHz band. As noted above, the Commission has since added a secondary allocation for AMSS in the 14.0-14.5 GHz band. *See Above 28 MHz Allocation Order*, 18 FCC Rcd at 23454, para. 76.

[15] *See* Satellite Communications Services Information, *Public Notice*, Report No. SES-00421 (rel. Aug. 21, 2002) and Report No. SES-00433, license re-issued to correct typographical errors (rel. Oct. 2, 2002).

[16] *Boeing Transmit-Receive Order*, 16 FCC Rcd at 22653-54, para. 19.

[17] Currently pending before the Commission is an application in which Boeing seeks authority for AES terminals to communicate with foreign-licensed satellites from aircraft located over the high seas (*i.e.*, international waters) and (continued....)

Commission authorized a number of changes to the Boeing's non-conforming use license, including authority for reflector antenna AES terminals in place of the initially licensed phased array antennas.[19] In 2004, Connexion by Boeing launched its satellite-based broadband in-flight Internet, data, and entertainment service on international flights.[20] Each plane equipped with the Connexion service offers either an Ethernet Local Area Network (LAN) connection or a wireless 802.11b network connection, or both.[21] The company has entered into agreements with numerous carriers[22] and expects to generate service revenues of $500,000 per airplane per year and annual revenues of $2 billion.[23] The Boeing service currently is available in the United States on government aircraft and executive jet platforms the size of a Boeing 737 and larger, including Airbus aircraft.[24] While Boeing's Connexion commercial service is currently available only on foreign airlines such as Lufthansa, Boeing has approached a number

(Continued from previous page)
additional satellites for use while an AES is over the United States. *See* The Boeing Company, Application to Modify Blanket AMSS Earth Station Authorization Call Sign E000723, File No. SES-MOD-20040301-00304 (filed March 1, 2004) ("Boeing International Waters Modification Application"). The Office of Engineering and Technology granted Boeing an experimental license to test 10 AES terminals over international waters. *See* Call Sign WC2XVE, File No. 0002-EX-ML-2004 (Jan. 13, 2004).

[18] Consistent with Presidential proclamation and the United Nations Convention on the Law of the Sea, the territorial waters would extend 12 nautical miles from the baselines of the geographic areas described in 47 U.S.C. § 153(51). *See* Presidential Proclamation No. 5928, 54 Fed. Reg. 777 (1988). This approach is consistent with the international law principle that each nation has exclusive jurisdiction over the airspace above its land territory and territorial waters. *See* U.N. Convention on the Law of the Sea, 21 I.L.M. 1261, at Part II, Art. 2 (opened for signature 1982).

[19] Boeing intended to keep 125 of its phased array antennas, while substituting 675 of them for reflector antennas, thereby maintaining a total of 800 AES terminals. *See* Boeing Modification Application, File No. SES-MOD-20030512-00639 and Satellite Communications Services Information re: Actions Taken, *Public Notice*, Report No. SES-00561, rel. Dec. 17, 2003.

[20] *See* "The New Era of Inflight Connectivity Is Here: Connexion by Boeing and Lufthansa Announce the World Premiere of Airborne Internet," Boeing Press Release, http://www.boeing.com/news/releases/2004/q2/nr_040511j.html (May 11, 2004).

[21] *See* Airline Advantages, http://www.connexionbyboeing.com/index.cfm?p=cbb.airlinesolutions&l=en.US&ec=. Boeing's website indicates that Connexion's "broadband speeds are comparable to land-based broadband networks such as cable or DSL." *Id.*

[22] Connexion had service agreements with Lufthansa, Scandinavian Airlines System (SAS), and Japan Airlines to equip their long-haul fleets with the Connexion service beginning in early 2004. In addition, British Airways has completed a successful service demonstration, and both All-Nippon Airways and Singapore Airlines have announced their intent to install the Connexion service on their long-range aircraft. *See* Boeing Petition at 2-3; "ANA and Connexion by Boeing Sign Definitive Internet Services Agreement," *Press Release*, http://www.boeing.com/news/releases/2004/q1/nr_040115j.html and "Singapore Airlines Selects Connexion by Boeing for In-Flight Connectivity," *Press Release*, http://www.boeing.com/news/releases/2003/q4/nr_031111j.html.

[23] Coffee, Tea or Broadband, Quentin Hardy, *Forbes* (June 17, 2004), available at http://www.forbes.com/technology/networks/2004/06/17/cz_qh_0617wifi.html.

[24] *See* Connexion by Boeing Executive Services Information Page at http://www.connexionbyboeing.com/index.cfm?p=cbb.executivejet&l=en.US&ec= and Boeing Petition at 3.

of U.S. airlines regarding installation of the Connexion service on their U.S.-registered aircraft.[25]

6. Aeronautical Radio Inc. ("ARINC") has filed an application seeking authority to offer, on a non-interference basis, a service similar to Boeing's Connexion.[26] While this application remains pending before the Commission, ARINC has begun testing its Ku-band AMSS system pursuant to a grant of experimental authority.[27] ARINC says that its SKYLink service can offer aircraft passengers uplink speeds between 512 kbps and 3 Mbps and downlink speeds up to 128 kbps.[28]

B. Petition for Rulemaking

7. On July 21, 2003, Boeing filed a Petition for Rulemaking, requesting that the Commission amend its rules to allocate AMSS in the 14.0-14.5 GHz band on a secondary basis and to adopt licensing and service rules for AMSS in the Ku-band.[29] Boeing generally supports Recommendation ITU-R M.1643, the ITU's recommended technical and operational requirements for AES terminals operating satellite uplinks in the 14.0-14.5 GHz band.[30] For example, Boeing recommends that to protect adjacent FSS networks in the Ku-band, the Commission should "ensure that the aggregate e.i.r.p. [effective isotropically radiated power] spectral density of all co-frequency AES transmissions will not exceed the levels generated by a routinely authorized VSAT under Section 25.134(a)(1) of the Rules. . . ."[31] Boeing also proposes that AMSS earth stations be subject to blanket licensing because AMSS systems "will employ large numbers of AES terminals operating on aircraft all over the world."[32] On October 2, 2003, the Commission released a public notice seeking comment on the Boeing Petition.[33]

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[25] Boeing Petition at 2; *see also* Boeing International Waters Modification Application, Public Interest Statement at 5. Some routes of these foreign carriers cover United States territory. *Id.*

[26] Aeronautical Radio Inc., Application for Blanket Authority to Operate Aboard Aircraft up to 1000 Technically-Identical Transmit and Receive Mobile Earth Stations in the 11.7-12.2 and 14.0-14.5 GHz Frequency Bands, File No. SES-LIC-20030910-01261, filed Sept. 10, 2003, and Amendment, File No. SES-AMD-20031223-01860, filed Dec. 23, 2003.

[27] *See* File No. 0054-EX-PL-2001, modified by File No. 0029-EX-ML-2003 and File No. 0029-EX-ML-2004 (Call Sign WC2XPE). The Office of Engineering and Technology recently extended ARINC's experimental authority to conduct a limited market study of its SKYLink service on 15 aircraft until May 1, 2006. *See* File No. 0130-EX-RR-2004.

[28] ARINC comments at 1-2.

[29] Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum in the 14-14.5 GHz Band to the Aeronautical Mobile-Satellite Service ("AMSS") and To Adopt Licensing and Service Rules for AMSS Operations in the Ku-Band, The Boeing Company, Petition for Rulemaking filed July 21, 2003 ("Boeing Petition" or "Petition").

[30] Boeing Petition at 15-20. Recommendation ITU-R M.1643 is reprinted in Appendix C.

[31] Boeing Petition at 15.

[32] Boeing Petition at 21.

[33] *See* Consumer and Governmental Affairs Bureau Reference Information Center, Petition for Rulemaking Filed, *Public Notice*, Report No. 2632, rel. Oct. 10, 2003.

8. The Commission received three comments and five reply comments, representing seven different parties, regarding the Boeing Petition.[34] The commenters generally supported the Boeing Petition, although PanAmSat Corporation objected to Boeing's proposals that AMSS license applications be subject to routine processing and that the Commission adopt a fixed effective isotropically radiated power ("e.i.r.p" or EIRP) density standard equivalent to that of VSAT power levels.[35] The portion of the Boeing Petition regarding a domestic secondary allocation for AMSS is now moot since the Commission has already made such an allocation.[36] The remainder of the issues raised in the petition are addressed in the relevant portions of the Discussion section below.

9. We recognize that AMSS operations on-board moving aircraft in the FSS spectrum present novel challenges to AMSS operators. The record established in this proceeding will allow the Commission to determine the effect of authorizing AES terminals and will facilitate the development of any future rules. Thus, in an effort to generate solutions to these novel challenges, throughout this proceeding we make proposals about the status of AMSS operations, and then we follow our proposals by seeking comment on alternatives to our proposals. Our goal is to develop approaches for licensing AES terminals that would maximize the efficient use of Ku-band spectrum while balancing the expectations of incumbent operators to operate free from harmful interference and to have growth potential in the bands.

III. DISCUSSION

10. We seek comment on rules for allocation and procedures for licensing AES terminals in the AMSS. Authorizing secondary status AES terminals in the Ku-band presents the challenge of protecting adjacent, primary status FSS satellites from the AES's potential harmful interference. We intend that, if adopted, such a licensing program would support the deployment of AMSS networks to the benefit of the American public without adversely affecting the operation and continued growth of incumbent radio services. We also intend to create a licensing program that ensures incumbent radio services are protected against harmful interference. To that end, we seek comment from individual operators of incumbent radio services in the Ku-band, including both federal government and non-government users. We request comments on the proposals addressed in this *Notice*. Further, we encourage all commenters to address any other issues concerning AMSS operations in the Ku-band. The record established in this

[34] *See* Appendix A for list of commenters.

[35] PanAmSat Corporation ("PanAmSat") comments at 1-3. PanAmSat argues that the Commission "has well-established procedures for processing of small diameter antennas, and has established a dividing line between those that are eligible for routine processing and those that are not." PanAmSat comments at 2. Further arguing that Ku-band AMSS systems "are anything but 'routine'," PanAmSat proposes that the Commission develop AMSS power limits on a case-by-case basis rather than adopt a fixed EIRP density standard. *Id.* In its reply comments, Boeing argues that "station parameters designed to provide interference protection are irrelevant to Ku-band AES operations." Boeing reply at 3. Boeing also says that development of case-by-case AMSS power limits reopens an issue already settled by the Commission in issuing Boeing's non-conforming use license to operate an AMSS system (*i.e.*, that routinely licensed VSAT power limits are appropriate for Ku-band operations), and moreover that such an approach would waste Commission resources. *Id.* at 3-5. These issues and arguments are addressed in greater detail in Section B (Technical and Operational Requirements for AES of AMSS networks in the band 14.0-14.5 GHz (Earth-to-space)), *infra*.

[36] *See Above 28 MHz Allocation Order*, 18 FCC Rcd at 23454, para. 76.

proceeding will allow the Commission to determine the impact of authorizing AMSS aircraft earth stations and will facilitate the development of any future rules. Establishing a licensing procedure for AMSS networks would advance our continuing effort to maximize the flexible use of the radiofrequency spectrum for earth station operations.[37]

11. Although the Commission adopted a secondary allocation for AMSS in the 14.0-14.5 GHz band in the *Above 28 MHz Order*, we propose to amend the U.S. Table of Frequency Allocations with the addition of a footnote regarding protection of co-secondary services. In this *Notice*, we also propose modifications of Part 25 of our rules to permit licensing of AES terminals in the Ku-band. We agree with the Boeing Petition commenters who state that the current system of granting AMSS operators non-conforming use licenses, on a non-interference basis, places an unnecessary administrative burden on operators and on the Commission, and casts too much regulatory uncertainty over AMSS providers.[38] We agree with Boeing and ARINC that non-conforming use licenses are not a long-term solution for addressing the licensing requirements of AMSS.[39] As explained below, a licensing procedure with established technical and operational requirements for AMSS network operations would provide a stable regulatory environment for AMSS operators, aircraft operators, service providers, and FSS licensees. Establishing a licensing procedure would also allow us to implement, in part, the decisions of the WRC-03.

A. Basis For AMSS Operations and U.S. Table of Frequency Allocations Issues

12. WRC-03 modified the International Table of Allocations to include a secondary allocation for AMSS in the 14.0-14.5 GHz band.[40] Following this action, the Commission amended the U.S. Table

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[37] *See* Principles for Reallocation of Spectrum to Encourage the Development of Technologies Telecommunications for the New Millennium, *Policy Statement*, 14 FCC Rcd 19868, 19870, ¶9 (1999) ("In the majority of cases," the Commission noted in 1999, "efficient spectrum markets will lead to use of spectrum for the highest value end use," and "[f]lexible allocations may result in more efficient spectrum markets."). *See also Amendment of the U.S. Table of Frequency Allocations to Designate the 2500-2520/2670-2690 MHz Frequency Bands for the Mobile-Satellite Service*, First Report and Order and Memorandum Opinion and Order, 16 FCC Rcd 17222, 17223, para. 2 (2001) (finding that investing incumbent licensees with more flexibility in the use of their assigned spectrum would foster the introduction of new services, promote competition, and permit market forces to determine the best use for the spectrum).

[38] Boeing Petition at 3; ARINC comments at 4; Rockwell Collins Corporation reply at 1-2.

[39] Boeing Petition at 3; ARINC comments at 4. However, we do seek comment below on whether to permit AMSS downlink operations in the 11.7-12.2 GHz on a non-conforming use basis. *See* para. 17, *infra*.

[40] ITU footnote 5.504A provides: "In the band 14-14.5 GHz, aircraft earth stations in the secondary aeronautical mobile-satellite service may also communicate with space stations in the fixed satellite service. The provisions of Nos. 5.29, 5.30 and 5.31 apply." ITU Radio Regulation Nos. 5.29. 5.30, 5.31 state that stations of a secondary service:

> 5.29 a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
>
> 5.30 b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;

(continued....)

of Frequency Allocations ("U.S. Allocations Table") in Section 2.106 of the its Rules to include a secondary allocation for AMSS in the 14-14.5 GHz band.[41] However, the Commission did not make an allocation for AMSS in the 11.7-12.2 GHz band, which is used for satellite downlinks to AES terminals. We propose to adopt a footnote to the U.S. Table of Frequency Allocations to address this issue.

1. Ku-Band

a. Downlink: 10.95-11.2 GHz & 11.45-12.2 GHz Bands

13. The allocations and operating conditions for portions of the Ku-band downlink spectrum will differ based on several factors, including the fact that commercial and government operations currently operate in portions of the Ku-downlink band. As such, we discuss each band separately below.

(i) 11.7-12.2 GHz

14. The 11.7-12.2 GHz band is allocated to the FSS for downlink operations on a primary basis and is extensively used for VSAT downlink operations.[42] In the *ESV Report and Order*, we added a footnote to the U.S. Table of Frequency Allocations stating that earth stations on board vessels (ESVs) are an application of the fixed-satellite service in the 11.7-12.2 GHz (space to Earth) and 14.0-14.5 GHz (Earth to space) bands.[43] In the *ESV Report and Order*, we also removed a secondary footnote allocation for Government and non-government fixed systems, and a secondary mobile (except aeronautical mobile) allocation in the 11.7-12.1 GHz band, under which the Local Television Transmission Service (LTTS) was licensed.[44] As of March 1, 2005, we will no longer consider LTTS license applications for the 11.7-12.1 GHz band, though we did "grandfather" pre-existing LTTS licensees to operate as a secondary mobile service in the 11.7-12.1 GHz band with the understanding that there will be no expectation of renewal.[45]

15. We propose to establish a new non-Federal government footnote for the 11.7-12.2 GHz band to indicate that AES terminals in the AMSS may operate with FSS space stations, so that parties are aware that mobile receivers may be operating in the band. This footnote would implement international footnote 5.504A, adopted at WRC-03. We believe our rules should clearly reflect the various types of operations that use a spectrum band. We also seek comment on whether AES terminals receiving in the 11.7-12.2 GHz band should be secondary to the FSS or, if they can maintain pointing accuracy toward geostationary satellite orbit (GSO) satellites, we should treat AES terminals the same as if they were

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5.31 c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

[41] *See Above 28 MHz Order*, 18 FCC Rcd at 23454, para. 76 and 47 C.F.R. § 2.106.

[42] *See* 47 C.F.R. § 2.106.

[43] Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands, IB Docket No. 02-10, *Report and Order*, FCC 04-286 (rel. Jan. 6, 2005) at para. 79 ("*ESV Report and Order*").

[44] *ESV Report and Order* at paras. 82-84.

[45] *ESV Report and Order* at para. 84.

earth stations in the FSS band (*i.e.*, as primary and, therefore, be subject to the receive antenna protection levels set forth in Section 25.209(c)[46]).

16. The ITU-R recognized that the use of the 14.0-14.5 GHz band for AMSS on a secondary basis was compatible with current FSS systems and was supported by studies leading up to WRC-03. Studies within the ITU-R assessed compatibility of the usage of the 11/12 GHz downlink band that is associated with the 14 GHz uplink band, and found that these downlink signals could co-exist with FSS systems. There is currently no domestic AMSS downlink allocation; thus domestic downlink signals currently operate under ITU Radio Regulation 4.4 in the 11/12 GHz band.[47] We tentatively conclude that matching the secondary AMSS uplink in the 14 GHz band with a secondary downlink allocation in the 11/12 GHz band would aid in the acceptance and standardization of these applications and we seek comment in this regard.

17. In the alternative, we seek comment on Boeing's argument that AMSS operations in the 11.7-12.2 GHz band continue to be authorized on a non-conforming use (*i.e.*, non-protected) basis.[48] Boeing argues that proposed AMSS operations use standard Ku-band FSS satellite transponders to provide service, and thus "[f]rom an interference perspective, there is no difference between an FSS transponder used for FSS downlink operations and the same FSS transponder used for AMSS downlink operations."[49] Boeing also argues that AMSS downlinks can operate effectively on an unprotected basis because "AES receivers must be designed to tolerate the 'noise' generated by other operations in the band."[50] Boeing also contends that authorizing AMSS downlinks as a non-conforming use provides AMSS systems with flexibility to operate in different frequency bands in different administrations.[51] We seek comment on these arguments.

(ii) *10.95-11.2 GHz and 11.45-11.7 GHz*

18. The frequency band 10.7-11.7 GHz is allocated internationally for FSS on a primary basis.

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[46] *See* 47 C.F.R. § 25.209(c).

[47] *See* Draft Preliminary views of IWG-2 on WRC-07, Agenda Item 1.6. ITU Radio Regulation 4.4. permits operation in any band on a non-interference and non-protected basis. The full text of ITU Radio Regulation 4.4 reads as follows: "Administrations of the Member States shall not assign a station to any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to , and shall not claim protection from harmful interference caused by, as station operating in accordance with the provisions of the Constitution, the Convention and these Regulations." *See* ITU Radio Regulation 4.4.

[48] Boeing Petition at 11. As Boeing points out in its petition, non-conforming use requires that (i) operations shall not cause harmful interference to any authorized station operating in compliance with the U.S. Table of Allocations, either domestically or internationally; (ii) operations must immediately cease upon notification of such harmful interference resulting from operations; and (iii) the non-conforming user must accept any interference from any authorized station.

[49] Boeing Petition at 11.

[50] Boeing Petition at 12.

[51] Boeing Petition at 12.

Within the United States, this band is referred to as the "extended" Ku-band,[52] and FSS use of this band is reserved for international systems by footnote NG104.[53] In the United States, these bands are also used by the fixed service for LTTS, Microwave Business, Microwave Public Safety, and Common Carrier Fixed Point-to-Point.[54] Boeing notes that Ku-band FSS downlinks are not restricted to the 11.7-12.2 GHz outside the United States, causing Boeing to design its AES terminals to receive "throughout the entire 10.7-12.75 GHz band to facilitate operations outside the United States."[55] Boeing suggests that "authorizing AMSS downlinks as a non-conforming use throughout internationally allocated FSS downlink spectrum" gives AMSS systems flexibility to operate globally and simultaneously protect other authorized band users.[56] We recognize that AES terminals on U.S.-registered aircraft may need to access foreign satellites while traveling outside of the United States (*e.g.*, over international waters), and therefore may need to downlink in the extended Ku-band in certain circumstances.[57] Within the United States, we do not anticipate that unprotected receive-only operations in the extended Ku-band would interfere with or restrict other authorized operations in the band. We seek comment whether AMSS operations in the 10.95-11.2 and 11.45-11.7 GHz bands should be permitted on a non-protected basis.[58] If not, we seek comment on alternative methods for permitting use of the extended Ku-band frequencies for AMSS downlinks.

b. 14.0-14.5 GHz Band

19. The U.S. Table of Frequency Allocations for the 14.0-14.5 GHz band includes a primary allocation for non-federal government FSS uplink operations.[59] This band is heavily used by Very Small Aperture Terminals ("VSATs") for uplinking to geostationary satellites.[60] These VSAT systems provide

[52] The so-called "extended Ku-band" includes allocations at 12.75-13.25 GHz, 13.75-14.0 GHz, 10.7-10.95 GHz, 10.95-11.2 GHz, 11.2-11.45 GHz, and 11.45-11.7 GHz. Within the "extended" Ku-band downlink, the 10.7-10.95 GHz and 11.2-11.45 GHz bands are authorized for use in accordance with ITU-R Appendix 30 B, which provides for the planned use of the GSO FSS. The rules we propose today would only apply to extended Ku-band downlink operations at 10.95-11.2 GHz and 11.45-11.7 GHz.

[53] *See* 47 C.F.R. § 2.106 n. NG 104 (stating that "[t]he use of the bands 10.7-11.7 GHz (space to Earth)...by the fixed satellite service in the geostationary-satellite orbit shall be limited to international systems, *i.e.*, other than domestic systems.").

[54] A search of the ULS database reveals that the majority of services using the band are Common Carrier Fixed Point-to-Point. There are a total of 2106 active Common Carrier Fixed Point to Point licensees, 164 active Microwave Business licensees, 410 active Microwave Public Safety licensees, and 73 active LTTS licensees.

[55] Boeing Petition at 12.

[56] Boeing Petition at 12.

[57] For example, Boeing requests authority to use extended Ku-band in its International Waters Modification Application. *See* Boeing International Waters Modification Application.

[58] Footnote NG 104 would not be applicable because the AES receivers would not need any coordination with fixed terrestrial services since they would operate on an unprotected basis.

[59] 47 C.F.R. § 2.106.

[60] Our database indicates that there are 2672 authorizations issued for GSO FSS earth stations in the 14.0-14.5 GHz band. The authorizations indicate the maximum number of earth stations or antennas that a licensee may deploy. For (continued....)

video and data communications and are widely deployed at business locations, ranging from the largest corporate headquarters to the smallest convenience stores. In 2001, the Commission also permitted NGSO FSS gateway and user terminal uplinks to operate in the 14.0-14.5 GHz band.[61] The 14.0-14.5 band GHz is also allocated for MSS, including aeronautical MSS, uplinks on a secondary basis for non-Federal government use.[62] This MSS allocation is presently used by OmniTracs, a satellite-based land mobile communications and tracking system that provides real-time messaging and position reporting between fleets and their operations centers.[63] As noted above, in the *ESV Report and Order*, we added a footnote to the U.S. Table of Frequency Allocations stating that earth stations on board vessels (ESVs) are an application of the fixed-satellite service in the 14.0-14.5 GHz band (for satellite uplinks).[64]

20. With regard to these services that operate across the entire 14.0-14.5 GHz band, we propose applying the standard primary/secondary sharing environment. We seek comment whether the co-secondary operations of AMSS and other MSS present any protection issues, and if so, how we should address them. We seek comment on whether ESV operations, operating on a primary basis, present any issues for consideration in connection with the authorization of AES terminals in the 14.0-14.5 GHz portion of the Ku-band. We concluded in the *ESV Report and Order* that AMSS secondary operations do not pose a concern for ESV primary operations.[65] Regarding normal FSS operations, we believe that following our two-degree spacing policy will protect existing and future FSS operations from harmful interference.[66] Accordingly, we propose to allow AES terminals to communicate with FSS space stations in the 14.0-14.5 GHz band on a secondary basis. We request comments on this approach. It should be noted that there are no primary fixed service allocations in any portion of the 14.0-14.5 GHz band. Below, we will consider how AMSS will co-exist with the various operations in sub-bands of the 14.0-

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example, since this is a VSAT band, a single GSO FSS authorization could cover several thousand VSAT Earth terminals.

[61] *See* Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range, ET Docket No. 98-206, *First Report and Order and Further Notice of Proposed Rule Making*, 16 FCC Rcd 4096 (2001). To date, the Commission has not issued any NGSO licenses in the 14.0-14.5 GHz band.

[62] *See* 47 C.F.R. § 2.106.

[63] Qualcomm's OmniTracs service processes more than six million transactions each day sent to and from a quarter-million trucks. *See* Qualcomm Service Keeps on Trucking, July 13, 2001 at http://www.business2.com/articles/web/print/0,1650,16490,FF.html.

[64] *ESV Report and Order* at para. 79.

[65] *ESV Report and Order* para. 88.

[66] In 1983, the Commission established a two-degree orbital spacing policy to maximize the number of in-orbit satellites serving the United States in either the C-band or the Ku-band. *See Licensing of Space Stations in the Domestic Fixed-Satellite Service and Related Revisions of Part 25 of the Rules and Regulations*, CC Docket No. 81-704, Report and Order, FCC 83-184, 54 Rad. Reg. 2d (P & F) 577 (1983); *summary printed in* Licensing Space Stations in the Domestic Fixed-Satellite Service, 48 Fed. Reg. 40,233 (Sept. 6, 1983), *on reconsideration, Licensing of Space Stations in the Domestic Fixed-Satellite Service and Related Revisions of Part 25 of the Rules and Regulations*, CC Docket No. 81-704, Report and Order, FCC 84-487, 99 FCC 2d 737 (1985). At that time, the Commission began assigning adjacent in-orbit satellites to orbit locations two degrees apart in longitude, rather than the three-to-four degrees longitude previously used.

14.5 band.

(i) 14.0-14.2 GHz Band

21. The 14.0-14.2 GHz portion of the Ku-band is allocated on a primary basis in the United States to FSS for non-Federal government operations and to radionavigation services for non-Federal government and Federal government operations. In WT Docket No. 01-289, the Commission has proposed to remove the radionavigation allocation from the 14.0-14.2 GHz band because it is not significantly used and could potentially conflict with various satellite operations in the band.[67] Therefore, we do not anticipate any interference conflicts between AES terminals and radionavigation operations, especially if the Commission adopts its proposal in WT Docket No. 01-289.

22. Space research services (for both Federal and non-Federal government use) are allocated to the 14.0-14.2 GHz sub-band on a secondary basis.[68] The only currently authorized non-FSS facilities in this portion of the Ku-band uplink are two National Aeronautics and Space Administration (NASA) space research Tracking and Data Relay Satellite System (TDRSS) receive facilities (located in Guam and White Sands, New Mexico), which operate with frequency assignments in the 14.0-14.05 GHz band.[69] We note that the interference rejection filtering associated with the existing TDRSS leaves them vulnerable to interference to varying degrees. The White Sands facility, for example, has only minimal interference rejection filtering across the entire 14.0-14.5 GHz band, while the Guam facility is somewhat better protected above 14.2 GHz.[70] We also note that NASA plans to establish another TDRSS receive facility on the east coast of the United States within 2-3 years, with several mid-Atlantic region sites under consideration. We would expect that any future NASA facilities operating in this band would be equipped with state-of-the-art interference rejection filtering.

23. We recognize the importance of protecting these space research facilities from receiving harmful interference. In the case of airborne transmitters which fly through the main beam or the near-in sidelobes of the TDRSS ground terminal, saturation may occur to current TDRSS receiver at frequencies throughout a significant portion of the 14.0-14.5 GHz band. With this is in mind, we propose to require that, as a prerequisite to licensing, AMSS operations in the 14.0-14.5 GHz band be coordinated with the

[67] *See* Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service, WT Docket No. 01-289, *Report and Order and Further Notice of Proposed Rule Making*, 18 FCC Rcd 21432, para. 85 (2003).

[68] *See* 47 C.F.R. § 2.106.

[69] *See Amendment of Parts 2, 25 and 73 of the Commission's Rules to Implement Decisions from the World Radiocommunication Conference (Geneva, 2003) (WRC-03) Concerning Frequency Bands Between 5900 KHz and 27.5 GHz and to Otherwise Update the Rules in this Frequency Range*, ET Docket No. 04-139, Notice of Proposed Rulemaking, FCC 04-74, 19 FCC Rcd 6592, 6609 n.74 (2004).

[70] The diplexer for the White Sands earth stations provides only 35 dB or less of interference attenuation from 14.35 to 14.5 GHz, while the diplexer at the Guam earth station provides little to no interference protection from 14.05 to 14.23 GHz, but provides 70 dB of attenuation at 14.48 GHz. *See* Letter from Robert E. Spearing, Deputy Associate Administrator for Space Communications, Office of Space Flight, NASA, to Craig Holman, Regulatory Counsel, The Boeing Company, at Figure 2 (December 18, 2001), *cited in* The Boeing Company, *Order and Authorization*, 16 FCC Rcd 22645, 22648 n.21 (Int'l Bur./OET 2001).

National Telecommunications and Information Administration (NTIA)[71] to resolve any potential concerns regarding space research facilities. We seek comment on this proposal. One option for completion of coordination may be an agreement on the part of the AES operator that it simply will not operate in the "vicinity of" the TDRSS station.[72]

24. With respect to future TDRSS sites, we also envision a coordination process. Under this process, NTIA would need to notify the Commission's International Bureau at least six months prior to operational status of any such new site. The Bureau would then issue a notice requiring all Ku-Band AMSS operators to complete coordination of their operations in the 14.0-14.5 GHz band through the FCC with the NTIA for the new TDRSS site, prior to the planned start date for operation of the new TDRSS site.[73] Due to the wideband nature of the TDRSS downlink signal, coordination between AES and TDRSS operations in the 14.0-14.5 GHz band is desirable for future TDRSS earth stations. However, we anticipate that NASA would endeavor to design any future TDRSS earth stations to minimize the coordination impact on AESs from TDRSS operations. Prior to the initiation of operations of any new TDRSS sites, during the coordination process, AES stations will continue to operate throughout the 14.0-14.5 GHz band in the vicinity of the future TDRSS site. After NTIA coordination has been completed for the new TDRSS receive site and the TDRSS site has become operational, AMSS operations would be permitted to operate in the 14.0-14.5 GHz band in the vicinity of the new TDRSS site, subject to any operational constraints developed in the coordination process. During the coordination period after NTIA notification of a new TDRSS site, should either party feel that an acceptable coordination agreement cannot be reached, the FCC and the NTIA will jointly resolve the matter.[74] If necessary, the Commission may be required to invoke Section 316 of the Communications Act to modify an authorization in order to protect TDRSS stations.[75] We seek comment on these proposals for the protection of space research sites. Additionally, we seek comment on whether a footnote should be added to the U.S. Table of Allocations that states that AES terminals operating in the 14.0-14.5 GHz band must ensure the protection of the space research operations.

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[71] NTIA is responsible for managing the government portion of the Table of Frequency Allocations. In bands shared between Federal and non-Federal Government services, the Commission and NTIA operate under a long-standing coordination agreement. *See* NTIA Manual, Basic Coordination Arrangement Between IRAC and the FCC, http://www.ntia.doc.gov/osmhome/redbook/NTIAmanual_May2003.pdf at Chapter 8.3.1.

[72] We understand that the "vicinity of a TDRSS site" refers to the area where an AES is in line-of-sight of the TDRSS site. Determination of the particular distance at which line-of-sight terminals must coordinate can be accomplished in a number of ways. For example, Section 25.213 uses a formula for determining the distance (d) at which airborne mobile earth stations in the 1.6/2.4 GHz band must coordinate with radio astronomy sites. That formula is d (km) = 4.1 square root of (h), where h is the altitude of the aircraft in meters above ground level. *See* 47 C.F.R. § 25.213(a)(1)(iv).

[73] This public notice would also indicate that the final operating parameters for the new site would be subject to coordination through the Frequency Assignment Subcommittee ("FAS") of NTIA's Interdepartment Radio Advisory Committee, if such coordination has not already been completed.

[74] We would expect that approximately three months prior to operation of the new TDRSS station, either party would, if circumstances require, notify the Commission and NTIA that a coordination agreement is not likely and Commission/NTIA decisions are necessary.

[75] *See* 47 U.S.C. § 316.

25. Since NASA will have a very limited number of space research Earth stations that will be receiving from the government data relay satellites, we believe that coordination between AMSS and TDRSS operations is possible and will not prove to be a burden for AMSS operators. In fact, Boeing has already provided us with evidence of a successful coordination with NASA regarding its TDRSS sites, including provision for future TDRSS sites.[76] In addition, the TDRSS sites provide an important service, and we do not anticipate that the number of TDRSS sites will increase significantly, and in any event, future expansion of the SRS could be severely curtailed if AMSS operators have no obligation to protect future TDRSS sites. For these reasons, we believe that protection of future co-secondary sites would be warranted. NTIA coordination should not unnecessarily delay Ku-band AMSS operators from initiating their licensed service in areas that may interfere with TDRSS sites. Indeed, Boeing and ARINC have already committed to protecting government users in this band.[77]

(ii) 14.2-14.4 GHz Band

26. Similar to the 11.7-12.2 GHz band, until recently, a secondary mobile allocation at 14.2-14.4 GHz was available for LTTS for television pickup and television non-broadcast pickup stations under Part 101 of our rules.[78] As of March 1, 2005, no new LTTS applications will be considered for this band, though pre-existing licensees have been grandfathered to operate as a secondary mobile service in the 14.2-14.4 GHz band with the understanding that there will be no expectation of renewal.[79] We propose making AMSS co-secondary with the grandfathered LTTS operations, and invite comment.

(iii) 14.4-14.5 GHz Band

27. In addition to the non-Federal government primary FSS and secondary MSS allocations in the 14.4-14.5 GHz segment, the Federal government has secondary FS and mobile allocations in the band. Our records indicate that there are several fixed point-to-point operations and a limited number of fixed stations used by the Federal government for terrestrial telecommand. There are also several Federal government aeronautical mobile stations, land-based aeronautical mobile stations, and land mobile stations in the band. Furthermore, there are several Federal government surface telemetering mobile stations in the band that are used to send telemetry information to other stations on the ground. The 14.4-14.5 GHz band appears to be used predominately by fixed, mobile, and transportable telemetry

[76] Letter from Robert E. Spearing, Deputy Associate Administrator for Space Communications, Office of Space Flight, National Aeronautics and Space Administration, to Craig Holman, Regulatory Counsel, The Boeing Company (dated Dec. 18, 2001). In connection with its pending AMSS application, ARINC filed a coordination agreement that it reached with NASA concerning its AES/TDRSS coordination. *See* Coordination Agreement Between the National Aeronautics and Space Administration (hereinafter "NASA") and ARINC, Incorporated (hereinafter "ARINC") for Operation of the ARINC SKYLink AMSS in the 14.0-14.5 GHz-Band, dated Sept. 3, 2004.

[77] *See* Letter from Robert E. Spearing, Deputy Associate Administrator for Space Communications, Office of Space Flight, National Aeronautics and Space Administration, to Craig Holman, Regulatory Counsel, The Boeing Company (dated Dec. 18, 2001) and Coordination Agreement Between the National Aeronautics and Space Administration (hereinafter "NASA") and ARINC, Incorporated (hereinafter "ARINC") for Operation of the ARINC SKYLink AMSS in the 14.0-14.5 GHz-Band, dated Sept. 3, 2004.

[78] *See ESV Report and Order* at para. 93; *see also* 47 C.F.R. § 101.147, note 24.

[79] *See ESV Report and Order* para. 94.

microwave systems. The band is also used to transmit air traffic control video links, closed circuit television, and range test data (including airborne downlink data transmissions). We seek comment on the extent to which the 14.4-14.5 GHz band is used to provide these various services.[80] Is it necessary to adopt any technical requirements or coordination procedures to protect these services adequately from AMSS operations in the 14.4-14.5 GHz band? If so, we invite parties to propose such technical or coordination requirements.

28. The Radio Astronomy Service (RAS) is allocated on a secondary basis internationally in the 14.47-14.5 GHz band, and pursuant to footnote US203 of the U.S. Table, radio astronomy observations of the formaldehyde line frequencies are permitted in this band at certain sites.[81] In keeping with our desire to provide full access to the 14.0-14.5 GHz uplink spectrum we propose to allow Ku-Band AMSS operators access to the spectrum between 14.47-14.5 GHz.[82] However, we do recognize the importance of radio astronomy for studying the universe. We also realize that ubiquitous airborne AES terminals have the potential to interfere significantly with RAS sites on the ground. With this is in mind, we propose to require that, as a prerequisite to licensing, AMSS operations in the 14.0-14.5 GHz band be coordinated with the NTIA to resolve any potential concerns regarding radio astronomy facilities. We seek comment on this proposal. One option for completion of coordination may be an agreement on the

[80] In the *ESV Report and Order*, we noted that we received no comment on secondary Federal Government mobile, fixed and transportable use of the 14.4-14.5 GHz band, and concluded that the standard primary/secondary sharing environment applies. *See ESV Report and Order* at para. 95.

[81] *See* 47 C.F.R. § 2.106, footnote US203. The sites identified in this footnote are the National Radio Astronomy Observatory, Green Bank, W. Va.; the National Radio Astronomy Observatory, Socorro, New Mexico; Hat Creek Observatory (U of Calif.), Hat Creek, Cal.; Haystack Radio Observatory (MIT-Lincoln Lab), Tyngsboro, Mass.; Owens Valley Radio Observatory (Cal. Tech.), Big Pine, Cal.; and Five College Radio Observatory Quabbin Reservoir (near Amherst), Massachusetts. Below, we propose a modification to update the list of sites contained in this footnote.

[82] We note that an interim process is currently in place to protect both SRS and RAS sites from AMSS operations in the 14.0-14.5 GHz band. By the conditions of its current non-conforming use license, Boeing may not constrain deployment of additional Federal Government stations operated by NASA in the SRS and Boeing must operate its system in accordance with its Technical Operational Coordination Agreement with the National Science Foundation to facilitate the protection of RAS. *See Boeing Transmit-Receive Order*, 16 FCC Rcd 22645. In the *Above 28 MHz Allocation Order*, we stated that until we adopt final rules relating to allocation changes in the 14.0-14.5 GHz band or licensing of AMSS terminals in that band, we will place the following conditions on any additional system authorizations that we may issue in that band for a service similar to Boeing's:

(1) The system shall be designed and operated so as not to cause harmful interference to TDRSS or RAS operations in the United States; and

(2) The system shall not constrain future deployment of additional Federal Earth Stations in the SRS and RAS authorized pursuant to existing allocations.

See Above 28 MHz Allocation Order, 18 FCC Rcd at 23454, para. 76. *See also* "Memorandum of Understanding Between the Federal Communications Commission and the National Telecommunications and Information Administration Addressing the Aeronautical Mobile-Satellite Service In the 14.0-14.5 GHz Band," July 8, 2002, at 2.

part of the AES operator that it simply will not operate in the "vicinity of" the RAS site.[83] We note that this proposal would require coordination for operations occurring outside the 14.47-14.5 GHz band in which radio astronomers observe the formaldehyde line. Although the U.S. Table of Frequency Allocations does not provide an allocation for radio astronomy in the 14.47-14.5 GHz band, the International Table of Frequency Allocations does provide a secondary allocation for RAS in this band.[84] In addition, Recommendation ITU-R M.1643 recommends protection of radio astronomy services by AMSS operations in the 14.0-14.5 GHz band, as opposed to only the 14.47-14.5 GHz sub-band.[85] We specifically seek comment on whether the sensitivity of U.S. RAS sites, combined with the limited signal attenuation of signals from AMSS stations, as compared to non-aeronautical platforms, may warrant coordination between RAS and AMSS operations throughout the 14.0-14.5 GHz band. We also seek comment on whether we should modify the status of RAS in the U.S. Table of Frequency Allocations to secondary, relative to AMSS. Under this proposal, RAS sites would have co-secondary status with regard to AMSS, but would retain their permissive status with regard to other services in the 14.47-14.5 GHz band. We seek comment on whether co-secondary status would be sufficient to protect the RAS from AMSS operations. We also seek comment on whether protection of co-secondary RAS sites should be limited to those sites listed in footnote US203.

29. We also seek comment on whether, and if so how, AMSS licensees should coordinate their operations with future RAS sites. If we require AMSS licensees to coordinate only with sites listed in footnote US203, the addition of new sites would be subject to the notice and comment rulemaking process in order to achieve modification of footnote US203. Alternatively, should coordination for future sites proceed on an ad hoc basis with each AMSS licensee, and if so, what framework should we establish to guide that coordination?

30. We note that radio observations in the 14.47-14.5 GHz band are not performed on a continuous basis and are usually scheduled in advance.[86] Thus, coordination between AMSS and RAS operations should be possible and should not unnecessarily delay Ku-band AMSS operators from initiating their licensed service in areas that may interfere with RAS sites. Nor do we believe that such coordination would be a burden for AESs. Indeed, both Boeing and ARINC have coordinated their AMSS operations with the National Science Foundation in this band.[87] We seek comment on whether Boeing's suggestion that, where practical, RAS observatories should be required to provide advance notice to AMSS operators regarding their observations,[88] should be implemented as part of the coordination proposal described above.

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[83] We understand that the "vicinity" of a radio astronomy site refers to the area where an AES is in line-of-sight of the radio astronomy site. *See also supra* n. 72.

[84] *See* 47 C.F.R. § 2.106.

[85] *See* Recommendation ITU-R M.1643 at Part C ("Essential requirements related to sharing with the RAS").

[86] *See ESV Report and Order* at para. 97.

[87] *See* Technical Operational Coordination Agreement for the Joint Usage of the Band 14.0-14.5 GHz Between the National Science Foundation and Aircraft Earth Stations Operating in the Boeing Connexion Aeronautical Mobile Network, dated Dec. 13, 2001 ("NSF Agreement") and A Coordination Agreement Between the National Science Foundation (herinafter "NSF") and ARINC, Incorporated (hereinafter "ARINC") for Operation of the ARINC SKYLink AMSS and Radio Astronomy Sites Jointly Sharing the 14.0-14.5 GHz-Band, dated September 24, 2004.

[88] Boeing Petition at 19-20, *citing* 47 C.F.R. § 25.213(a)(1)(vi).

c. Proposed Footnotes

31. Based on our proposals to permit AES terminals in the 11.7-12.2 GHz and 14.0-14.5 GHz bands to communicate with space stations of the FSS, we propose to add the following non-Federal government footnote NGyyy to the U.S. Table of Frequency Allocations for these bands:

> **NGyyy** In the bands 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space), aircraft earth stations in the aeronautical mobile-satellite service are an application of the Fixed-Satellite Service (FSS). The provisions of ITU Radio Regulations Nos. 5.29, 5.30 and 5.31[89] apply, except that reception from geostationary space stations in the fixed-satellite service in the 11.7-12.2 GHz shall be protected in the United States on a primary basis, provided that the aircraft earth stations operate under the same parameters as earth stations in the fixed-satellite service.

We seek comment on this proposal.

32. In order to protect government space research operations, we propose to add the following Federal government footnote USxxx to the U.S. Allocations Table for the 14.0-14.5 GHz band:

> **USxxx** In the band 14.0-14.5 GHz, operations of Aeronautical Mobile-Satellite Service earth stations are subject to coordination with NTIA in order to minimize interference to NASA's Tracking and Data Relay Satellite System (TDRSS) earth stations and the radio astronomy sites listed in US203 that observe in the 14.47-14.5 GHz band.

We seek comment on this proposal.

33. We take this opportunity to seek comment on updating the list of RAS sites currently listed in footnote US203 to the U.S. Table of Allocations. This footnote lists sites used for radioastronomy observations of the formaldehyde line frequencies 14.470-14.500 GHz at specific observatories (presently, National Radio Astronomy Observatory, Green Bank, W. Va.; National Radio Astronomy Observatory, Socorro, New Mexico; Hat Creek Observatory (U. of Calif.), Hat Creek, Cal.; Haystack Radio Observatory (MIT-Lincoln Lab), Tyngsboro, Mass.; Owens Valley Radio Observatory (Cal. Tech.), Big Pine, Cal.; Five College Radio Astronomy Observatory Quabbin Reservoir (near Amherst), Mass.).[90] We seek comment whether the sites currently described in US203 accurately reflect all the

[89] ITU Radio Regulation Nos. 5.29. 5.30, 5.31 state that stations of a secondary service:

> 5.29 a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date;
>
> 5.30 b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;
>
> 5.31 c) can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

[90] Specifically, this footnote says that "[e]very practicable effort will be made to avoid assignment of frequencies to stations in the fixed or mobile services in these bands [*i.e.*, 4825-4835 MHz and 14.470-14.500 GHz]. Should such assignment result in harmful interference to these observations, the situation will be remedied to the extent practicable." *See* 47 CF.R. § 2.106, US203.

sites actually observing the formaldehyde frequency lines at 14.470-14.500 GHz. For example, the Technical Operational Coordination Agreement that Boeing and the National Science Foundation entered into in 2001 ("NSF Agreement") regarding protection of radio astronomy sites that observe in the 14.47-14.5 GHz band lists a number of sites that are not currently listed in footnote US203.[91] The sites listed in the NSF Agreement are:

Observatory	West Longitude	North Latitude	Elevation
Arecibo Observatory	66° 45' 11"	18° 20' 46"	496 m
Green Bank Telescope (GBT)	79° 50' 24"	38° 25' 59"	825 m
Very Large Array (VLA), Socorro, NM	107° 37' 04"	34° 04' 44"	2126 m
Very Long Baseline Array (VLBA) Stations:			
Brewster, WA	119° 40' 55"	48° 07' 53"	255 m
Fort Davis, TX	103° 56' 39"	30° 38' 06"	1615 m
Hancock, NH	71° 59' 12"	42° 56' 01"	309 m
Kitt Peak, AZ	111° 36' 42"	31° 57' 22"	1916 m
Los Alamos, NM	106° 14' 42"	35° 46' 30"	1967 m
Mauna Kea, HI	155° 27' 29"	19° 48' 16"	3720 m
North Liberty, IA	91° 34' 26"	41° 46' 17"	241 m
Owens Valley, CA	118° 16' 34"	37° 13' 54"	1207 m
Pie Town, NM	108° 07' 07"	34° 18' 04"	2371 m
St. Croix, VI	64° 35' 03"	17° 45' 31"	16 m

We seek comment on revising footnote US203 to list these, or other, sites as the ones that observe the formaldehyde line frequencies in the 14.47-14.5 GHz band. We also seek comment on whether the current list is accurate, *i.e.*, whether any of the observatories listed are no longer active.[92]

B. Technical and Operational Requirements for AES of AMSS networks in the band 14.0-14.5 GHz (Earth-to-space)

1. Essential Requirements Related to the Protection of Adjacent Satellite Operators

a. Off-Axis e.i.r.p. Density Limits and Associated Conditions

34. Adopted at WRC-03, ITU recommendation ITU-R M.1643 suggests that the AMSS networks should be coordinated and operated in such a manner that the aggregate off-axis e.i.r.p. density levels produced by all co-frequency AES terminals within AMSS networks are no greater than the interference levels that have been published and coordinated for the specific and/or typical earth station(s) pertaining

[91] *See* Technical Operational Coordination Agreement for the Joint Usage of the Band 14.0-14.5 GHz Between the National Science Foundation and Aircraft Earth Stations Operating in the Boeing Connexion Aeronautical Mobile Network, dated Dec. 13, 2001 ("NSF Agreement").

[92] Specifically, we note that in comments filed in IB Docket No. 02-10, the National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies (CORF), stated that radio observations are no longer performed in the 14.47-14.5 GHz band at the Hat Creek, Tyngsboro, or Amherst sites. CORF comments at 5, IB Docket No. 02-10, at 5 (March 3, 2004).

to FSS networks where FSS transponders are used.[93] As Boeing notes, this means that "AMSS systems should be designed, coordinated and operated in such a manner that the aggregate off-axis e.i.r.p. density levels produced by all co-frequency AES terminals are no greater than the interference levels that have been coordinated for the FSS satellite system being used."[94]

35. In its Petition, Boeing states that for Ku-band AES terminals communicating with FSS satellites, the starting point for protecting adjacent FSS networks is contained in 47 C.F.R. §§ 25.134(a)(1) and 25.209, relying on the Commission's 2-degree orbital spacing rules rather than operator-to-operator coordination agreements.[95] Based on its experience, Boeing believes that instead of imposing separate antenna performance requirements and input power levels, AMSS licensing rules need only ensure that the aggregate off-axis EIRP density of all co-frequency AES transmissions will not exceed the levels generated by a routinely authorized VSAT under Section 25.134(a) (1) (maximum input power density of -14 dBW/4 kHz into an antenna with side lobes specified in section 25.209 (a) (1)) to protect satellite operations in a 2-degree spacing environment.[96] Boeing suggests that in the view of maximum VSAT power and antenna gain requirements noted above, AES aggregate off-axis EIRP density along the geostationary satellite's orbital arc for co-polarized signals should not exceed the following values:

Angle off-axis	Maximum e.i.r.p density in any 4 KHz band
$1.0° \leq \Theta \leq 7.0°$	$15 - 25 \log \Theta$ dBW
$7.0° < \Theta \leq 9.2°$	-6 dBW
$9.2° < \Theta \leq 48°$	$18 - 25 \log \Theta$ dBW
$\Theta > 48°$	-24 dBW[97]

36. In its comments on the Boeing Petition, PanAmSat suggests that the Commission should develop AMSS power limits on a case-by-case basis rather than adopting a fixed e.i.r.p density standard for AMSS stations equivalent to that of VSAT power levels, as Boeing suggested.[98] Boeing asserts that PanAmSat "seeks to reopen the debate on power limits in the context of each and every AMSS licensing proceeding."[99] We recognize that for Ku-band AES terminals communicating with FSS satellites, the

[93] *See* Recommendation ITU-R M.1643 at Annex 1, Part A, Section 1.

[94] Boeing Petition at 14.

[95] Boeing Petition at 14.

[96] Boeing Petition at 14-15. *See also* 47 C.F.R. §§ 25.134, 25.209.

[97] Boeing Petition at 15.

[98] PanAmSat comments at 2.

[99] Boeing Reply Comments at 3.

starting point for protecting adjacent FSS networks is contained in 47 C. F.R. §§ 25.134(a)(1) and 25.209. We understand that adopting an aggregate off-axis EIRP density limit will give more flexibility to Network Control and Monitoring Centers (NCMCs) in assigning power limits to AES for simultaneous co-frequency transmissions, while satisfying the aggregate value. Specifically, this will permit AES terminals to have different off-axis e.i.r.p. density values depending on each AES characteristics. However, considering the fact that AES terminals are moving rapidly and a network's topology is changing continuously, enforcement and control of off-axis EIRP density limits on individual AES terminals might be simpler for NCMCs than controlling an aggregate value. Therefore, alternatively, we seek comment on adjusting the AES off-axis EIRP envelope in Boeing's proposal to apply to individual AES terminals. Specifically, we invite comment on limiting the AES off-axis e.i.r.p. density along the geostationary satellite orbital arc for co-polarized signals to the following values:

Angle off-axis	Maximum e.i.r.p density in any 4 KHz band
$1.0° \leq \Theta \leq 7.0°$	$15 - 25 \log \Theta$ dBW
$7.0° < \Theta \leq 9.2°$	-6 dBW
$9.2° < \Theta \leq 48°$	$18 - 25 \log \Theta$ dBW
$\Theta > 48°$	-24 dBW

Where: Θ is the angle in degrees from the axis of the main lobe.

The off-axis EIRP density limits listed here pertain to emissions from a single transmitter if the selected modulations permit one carrier per channel at the satellite receiver. If an AMSS operator chooses to implement a modulation technique, such as CDMA, that can operate with multiple co-frequency transmissions from different AES terminals being simultaneously received at the same satellite, we propose introducing equal off-axis EIRP density limits on each individual AES. That is, if "N" AES transmitters were implemented, each operating on the same channel, transmitting to the same satellite, at the same time, the EIRP density limit on each individual transmitter would be reduced by a factor of 10*log(N), in dB. For example, if five AES terminals were equipped with CDMA AMSS transmitters all operating to the same satellite, in the same uplink bandwidth, the e.i.r.p. density of the individual transmitters would be reduced by a factor of 10*log(5) = 7.0 dB.

37. We believe that both of the proposed approaches mentioned above (*i.e.*, Boeing's aggregate off-axis e.i.r.p. density limits and our individual off-axis e.i.r.p. density limits) have their own advantages and disadvantages. Therefore we seek comment on both approaches and feasibility of each in practice. Also we seek comment whether we should be concerned about the approach used by an applicant as long as the applicant's system meets the aggregate envelope.

38. In addition, Boeing argues that the Commission should permit minor variances in the off-axis e.i.r.p density values to account for variations in antenna performance where such variances would not adversely affect adjacent satellite operators.[100] We recognize that the antenna gain variations captured in

[100] Boeing Petition at 16.

§25.209(a), for Ku-band antennas, are part of the VSAT antenna envelope, therefore, we propose that the e.i.r.p density of an individual sidelobe may not exceed the envelope defined above for Θ between 1.0 and 7.0 degrees. For Θ greater than 7.0 degrees, we propose that the envelope may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the e.i.r.p density envelope given above by more than 3 dB. We seek comment on these values.

39. Boeing states that, since AMSS receivers will operate on an unprotected basis in the 11.7-12.2 GHz band, there is no need to specify the antenna performance requirements which protect receive operations from interference caused by adjacent satellite downlinks.[101] PanAmSat in its comments suggests a modification to Boeing's draft AMSS rules. PanAmSat asserts that Boeing is proposing that the applications for blanket licenses be subject to routine processing, without regard to the diameter of the AMSS stations and the angle at which the AMSS stations conform to the "29-25 log Θ" standard.[102] PanAmSat believes that "the Commission has well-established procedures for processing small diameter antennas, and has established a dividing line between those that are eligible for routine processing and those that are not."[103] Furthermore PanAmSat argues that if FSS earth stations that fall "below the line," and that are operating on a primary basis in the Ku-band, are not eligible for routine processing, neither should "below the line" AMSS stations that are operating on a secondary basis.[104] In its reply comments, Boeing states that the primary purpose of specifying the gain characteristics of FSS earth station antennas is to define the protection they receive as a primary service.[105] Boeing asserts that in contrast, AMSS receive operations are conducted in the 11.7-12.2 GHz band on an unprotected basis only and by definition, cannot claim protection from other conforming users of the band; therefore, Boeing argues that it is illogical to suggest that AMSS service rules must specify the gain characteristic of AMSS receive antennas in that frequency band.[106] We seek comment on the relationship between unprotected receive operations of AES terminals in the 11.7-12.2 GHz band and technical standards (*e.g.*, antenna performance standards, if necessary), applicable to those operations.

40. Boeing also asserts that, like Ku-band VSAT operators, AMSS systems should have the flexibility to coordinate AES transmissions in excess of these e.i.r.p. density values, subject to an additional technical showing and the rights of future Ku-band licensees to require compliant operations in certain circumstances.[107] ARINC supports Boeing's proposed rule.[108] Boeing argues that evidence of operator-to-operator coordination regarding adjacent satellite interference can be demonstrated "by

[101] Boeing Petition at 15.

[102] PanAmSat comments at 2.

[103] PanAmSat comments at 2.

[104] PanAmSat comments at 2. We believe that in referring to "below the line" applications for Earth stations, PanAmSat is referring to stations with a diameter smaller than that referenced under current Section 25.209, therefore making the application ineligible for routine processing. *See* 47 C.F.R. § 25.209.

[105] Boeing reply at 3.

[106] Boeing reply at 3.

[107] Boeing Petition at 15.

[108] ARINC comments at 6.

obtaining a certification from their satellite providers that the aggregate off-axis e.i.r.p. density levels produced by all co-frequency AES terminals communicating with the relevant satellite will be no greater than the interference levels that have been accepted by adjacent satellite systems through the operator-to-operator coordination process."[109] Our first question for comment is whether, in the first instance, we should consider granting any AMSS application for a system that exceeds our proposed EIRP density levels. If such applications should be considered, we propose a certification procedure similar to what Boeing recommends. We note that the Commission proposed a certification procedure similar to the Boeing proposal for FSS earth stations considered "non-routine" under the current Part 25 rules.[110] We seek comment on whether those streamlined procedures are appropriate for AMSS in the event that either we do, or do not, adopt our off-axis EIRP envelope proposal.

b. Antenna Pointing Accuracy

41. Consistent with ITU Recommendation ITU-R M.1643,[111] Boeing's Petition,[112] and the *Boeing Transmit-Receive Order*,[113] we propose that an AMSS applicant will need to provide information demonstrating that it has accounted for the following factors in the design, coordination and operation of an AES and we seek comment in this regard. These factors could vary the aggregate off-axis e.i.r.p. density levels generated by the AES:

i. Mispointing of AES antennas. This includes, *e.g.*, effects caused by bias and latency of their pointing systems, tracking error of closed loop tracking systems, misalignment between transmit and receive apertures for systems that use separate apertures, and misalignment between transmit and receive feeds for systems that use combined apertures; therefore, consistent with WRC-03, we are proposing that the AES operator should maintain pointing accuracy within 0.2 degrees for all antennas within its licensed network.

ii. Variations in the antenna pattern of AES. This includes, *e.g.*, effects caused by manufacturing tolerances, ageing of the antenna and environmental effects. AMSS networks using certain types of AES antennas, such as phased arrays, should account for variation in antenna pattern with scan angles (elevation and azimuth). Networks using phased arrays should also account for element phase error, amplitude error and failure rate;

iii. Variations in the transmit e.i.r.p. density from AES. This includes, *e.g.*, effects caused by measurement error, control error and latency for closed loop power control systems. Network control and monitoring centers (NCMCs) that calculate the e.i.r.p. density of AES based on the received signal need to take

[109] Boeing Petition at 16.

[110] *See* 2000 Biennial Regulatory Review Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations, IB Docket No. 00-248, *Notice of Proposed Rulemaking*, 15 FCC Rcd 25128 (2000) ("*Part 25 Earth Station NPRM*").

[111] *See* Recommendation ITU-R M.1643 at Annex 1, Part A, Section 2.

[112] Boeing Petition at 17.

[113] *See Boeing Transmit-Receive Order*, 16 FCC Rcd at 22655.

into account error sources and latency in this calculation. NCMCs that calculate the e.i.r.p. density of AES based on input power must account for measurement error and reporting latency.

We seek comment on each of these proposals.

c. Additional Requirements

42. We seek comment on several rule revisions that would be consistent with ITU Recommendation ITU-R M.1643,[114] and Boeing's proposed rules.[115] First, we propose that AES terminals that use closed loop tracking[116] of the satellite signal need to employ an algorithm that is resistant to capturing and tracking adjacent satellite signals. AES terminals would have to immediately inhibit transmission when they detect that unintended satellite tracking has happened or is about to happen. We seek comment on this proposal.

43. We also propose that the AES terminals should be subject to the monitoring and control of a NCMC or equivalent facility, located within the United States. Under this proposal AES terminals must be able to receive at least "enable transmission" and "disable transmission" commands from the NCMC. AES terminals would have to automatically cease transmissions immediately upon receiving any "parameter change" command, which may cause harmful interference during the change, until the AES receives an "enable transmission" command from its NCMC. In addition, it should be possible for the NCMC to monitor the operation of an AES to determine if it is malfunctioning. ARINC in its comments supported Boeing's proposed rule in this regard.[117] Our proposal regarding NCMC control is consistent with the Bureau's action in *Boeing Transmit-Receive Order*.[118]

44. Finally, we propose that AES terminals need also to be self-monitoring and if an individual AES detects a fault which can cause harmful interference to FSS networks, the AES must automatically mute its transmissions until the cause of harmful interference has been remedied. This would also be consistent with the Bureau's action in *Boeing Transmit-Receive Order*.[119] We seek comment in this regard.

2. Essential Requirements Related to the Protection of the Fixed Service

45. In its Petition, Boeing argues that since there is no allocation for terrestrial FS operations in the 14.0-14.5 GHz band in the United States or any bordering countries, there should not be any

[114] *See* Recommendation ITU-R M.1643 at Annex 1, Part A, Section 3.

[115] Boeing Petition at 18.

[116] Closed loop logic is deployed to overcome various faults that may cause unintended satellite tracking. In closed loop systems a feedback is used to see if the desired tracking has taken place by measuring the difference between the input and output signals and the corrective action takes place as the result of comparison.

[117] ARINC Comments at 6.

[118] *See Boeing Transmit-Receive Order*, 16 FCC Rcd at 22654, para. 19h.

[119] *See Boeing Transmit-Receive Order*, 16 FCC Rcd at 22654-55, para. 19h.

requirements for protection of fixed service in the Commission's Rules with respect to domestic operations.[120] However, Boeing states that AMSS providers operating in the international airspace near territories with co-frequency FS operations should be required to protect such operations from harmful interference.[121] Further, in its comments, Boeing suggests that, when operating co-frequency with terrestrial FS stations within the line of sight of the territory of a foreign Administration that has a primary FS allocation in the 14.0-14.5 GHz band, the operations of an AES should be in accordance with Annex 1, Part B of the latest version of Recommendation ITU-R M.1643, unless the foreign Administration has imposed other conditions for protecting its FS stations.[122] Boeing says that such alternative conditions may be included in the authorization of the AMSS network to operate within the territory of a foreign Administration (*i.e.*, the authorization issued by the foreign administration) or pursuant to a coordination agreement with the foreign administration governing the operations of the AMSS network.[123]

46. Boeing's recommendation on this issue warrants further consideration. Accordingly, we propose that, when AMSS providers operate in the 14.0-14.5 GHz frequency band in the international airspace within line-of-sight of the territory of a foreign administration where fixed service networks have primary allocation in this band, the maximum power flux density (pfd) produced at the surface of the Earth by emissions from a single AES of an AMSS network should not exceed the following values unless the foreign Administration has imposed other conditions for protecting its FS stations:

$$-132 + 0.5 \cdot \theta \text{ dB}(W/(m^2 \cdot MHz)) \quad \text{for} \quad \Theta \leq 40°$$

$$-112 \text{ dB}(W/(m^2 \cdot MHz)) \quad \text{for} \quad 40° < \Theta \leq 90°$$

Where: θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal) and the aforementioned limits relate to the pfd and angles of arrival would be obtained under free-space propagation conditions.

We seek comment on an alternative proposal that these pfd limits apply only in the absence of an explicit adoption of different conditions by a foreign administration.[124] We also invite comment on Boeing's proposal that in cases where AMSS operations may affect FS operations in more than one country simultaneously, the protection requirement to be applied "should be the most stringent requirement needed to protect a FS station within the jurisdiction of a potentially affected administration."[125]

[120] Boeing Petition at 19.

[121] Boeing Petition at 19.

[122] Boeing comments at 10. *See also* Recommendation ITU-R M.1643.

[123] Boeing comments at 10.

[124] *Cf.* Boeing comments at 9. Boeing suggests that an AMSS operator may be subject to alternative operating conditions in a foreign administration via either a coordination agreement or conditions included in a foreign authorization. *See also* Boeing comments at 9-10.

[125] Boeing comments at 9.